

edge of the island-like patch of paleozoic rocks near Doylestown, in fact does not go through the Chalfont cut at all ; but nevertheless probably passes within a hundred yards north of it, as is shown by neighboring rock exposures on the other side of the fault and by changes in the color and character of the soil. There is no reason to suppose that the fault, great as it is, heaves in the least the trap dike that does probably exist pretty close north of it ; and the trap that occurs within two miles and a half south of the fault at four or five miles to the east must undoubtedly belong to quite a separate dike. Instead of one great dike there seem to be several smaller ones not continuous nor quite in line.

On Apatela.

By A. Radcliffe Grote, A.M.

(Read before the American Philosophical Society, October 18, 1895).

The genus *Apatela* has awakened considerable interest on account of the diversity of types among the larvæ of the different species. As will be seen from my lists of the N. American species, these greatly exceed in number the European, and probably afford a larger number of these larval types ; while nearly all of the European groups are represented in North America, the Agrotid fauna of the two continents being, as often insisted upon by me, closely related. It follows that our nomenclature is derived chiefly from European sources. It may be said that the Apatelidæ are difficult to distinguish from the Arctiidæ, by exclusive characters drawn from the imago.

I have only quite recently become acquainted with the extremely beautiful work of Dr. T. A. Chapman, on the genus *Acronycta* (*Apatela*) and its allies, London, 1893, a publication which at once placed its author among the foremost of the students of the new Lepidopterology, a school which has entirely broken with the old system under which the study had become sterilized, and was in danger of passing entirely into the hands of fanciers and dealers, at least in Europe. The results of the New School may be estimated by the statement, that the spectres of the metaphysical groups "*Bombycidæ*," "*Zygænidæ*," "*Noctuidæ*," "*Tineidæ*," which, especially the former, haunted our nomenclature, have been effectually exorcised. The "*Bombycidæ*" have been shown to be composed of families belonging to no less than three superfamilies: *Bombycides*, *Agrotides*, *Tineides* ; the results attained through phylogenetic and ontogenetic studies are now applied to classification.

In my list published in these *Proceedings* in 1883, I had separated the three families of which the "*Noctuidæ*" were then composed, and this classification is the basis of the catalogue published as Bulletin No. 44, of the National Museum, Washington, 1893. Recent studies of Mr. Harrison

G. Dyar show, that we must place my Thyatiridæ between the Geometridæ and the Ptilodontidæ and divide the family * Noctuidæ (a preoccupied name in Aves which I have accordingly rejected from the Lepidoptera) into two distinct families, upon larval structure, my Apatelidæ and Agrotidæ.

The families adopted by the new Lepidopterology may have exclusive characters offered in the larval stage. See Mr. S. H. Scudder's *Historical Sketch*, 103, where the statement is made, that generic distinctions are as easily traced in the larva as in the imago. If generic, then also family characters, since I have shown that the characters upon which all our divisions are based do not differ in essential respects *Papilio*, 3, 36, 1883. The family Apatelidæ has for its type *Apatela aceris* of Europe and includes, besides the typical genus *Apatela* (*Apatela*, *Acronycta* of authors), the genus *Diptera* Hübner, 1806 (1811), with its type *orion*, to which genus our *fallax* belongs. Here belong also the genera *Microcœlia* and *Harrisimemna*. Other genera included by me in May, 1895, my last list of our species, are probably correctly referred here, but *Raphia* is shown by Mr. Dyar to be wrongly included and should apparently be removed to the Agrotidæ near *Episema*. The larva of *Leptina* (*Baileya*) is unknown and this stage of several other genera incompletely studied, so that there will be some possible necessary changes. My last list had for its special object the fixing of the generic types and the restitution of the oldest rightful names. It had little or no changes in arrangement to propose; but I may mention here, that the genera *Calocampa* and *Lithomoia* should be classed by themselves under the tribe Calocampini Grt., 1890, taken out of the Orthosiini; while *Lithophane* and allies should not go with them, but remain in the Orthosiini, to which group they naturally belong. The question of whether we are to assign tribal or subfamily rank to these divisions of the Agrotidæ, has not been satisfactorily solved. But the possibility of a division into groups of the Agrotidæ is now virtually admitted, against Lederer's rejection of all such assistance to classification. More recently Hampson has proposed a division into subfamilies. The number of generic titles proposed for species of the genus *Apatela* in Europe is considerable and their correlation with structural groups a difficult task. I have applied to the names the historical method, with the result here noted. The subgeneric groups here proposed are of unequal, and in some cases, *i. e.*, *Arctomyseis*, of doubtful value. Yet there is no reason for their rejection without very careful study, above all of the American species which may throw fresh light upon their standing. In the case of *Jochœera*, the discovery of the American *funeralis* assists the view that the group is natural and therefore valid. The clubbed hairs are peculiar, reminding one of the primary hairs of *Saturnia pavonia major*.

* See my *Systema Lepidopterorum Hildesæ*, August 15, 1895. Since then I have received Dr. Chapman's papers which show the affinity of the Cossidæ and Tortricidæ, the former family should therefore immediately precede the latter. The family Eriocephalidæ should be added at the last. For this Packard quite recently proposes the suborder *Lepidoptera laciniata*.

Gen.: APATELA Hübn., 1806 (1811).

Type: *A. aceris*.

(a) EUROPEAN SPECIES.

Subgenera:

1. *Triæna* Hübn., 1818, type: *psi*; *tridens*, *cuspis*.
2. *Hyboma* Hübn., 1818, type: *strigosa*.
3. *Jocheæra* Hübn., 1818, type: *alni*.
4. *Acronicta* Ochs., 1816, type: *leporina*.
5. *Apatela* Hübn., 1811, type: *aceris*.
6. *Cuspidia* Chapman, 1893, type: *megacephala*.
7. *Pharctra* Hübn., 1818, type: *auricoma*; *rumicis*.
8. *Arctomyscis* Hübn., 1818, type: *euphorbiæ* (*euphrasiæ*).
9. *Viminia* Chapman, 1893, type: *menyanthidis*.
10. *Bisulcia* Chapman, 1893, type: *ligustri*.

Of *Triæna*, Guenée's generic term *Semaphora* is a synonym, having the same type. Dr. Chapman's objection, that Guenée did not include the whole group, is not valid, since the rules under which the nomenclator works deal with names applied to any member of a group. It were too much to demand of genera and species makers, those *avant couriers* of biological research, that they announce at once the discoveries of Müller, Dyar or Chapman. The distinction offered by *Arctomyscis* as restricted by me is of doubtful value; it appears to be nearly limited to the white secondaries of the male. The term *Polymixis* Hübn., 1818, is restricted to *polymita* L., under Chapman's action in taking out *ligustri* in 1893. Upon becoming autoptically acquainted with *euphorbiæ*, I find that this species passes under the name *euphrasiæ* in North Germany. It is so named in the museum here; it is this species I intended to designate as type of the term *Arctomyscis*. There appears to be another *euphrasiæ* in South Germany, which may or may not be different. I have not seen it. These types for the most part are fixed by me in 1874-1876; the action should be respected, unless it can be properly overturned.

(b) AMERICAN SPECIES.

There are first to be separated, as distinct genera probably, *Meronlonche* Grt., which contains two Californian species with the type: *spined* Grt., and *Eulonche* Grt., from the Atlantic district, with three species: *oblinita* Abb. and Sm. (= *salicis* Harris), which is the type, *lanccolaria* Grt., and *insolita* Grt. This latter genus is characterized by its pointed wings and sunken head and has no European representative. It shares with *Mastiphanes* a Lithophanoid ornamentation. I have not been able to recognize any American representatives of the s. g. 2. *Hyboma*; my *vinnula* must be compared. Of 1. *Triæna*, we

have a strictly representative species in *occidentalis* G. and R., and the same is true of 3. *Jocheæra*, where we have *funeralis* G. and R. Of 4. *Æronicta*, we have probably several species, such as *lepusculina*, *vulpina* and *felina*. Of 6. *Cuspidia*, I know of none, but it is not unlikely that an analogue of *megacephala* may be found. Of 5. *Apatela*, it is probable that we have several, but the synonymy is not clear, since Abbot's *aceris* (*acericola*) and *hastulifera* are not surely made out. Guenée's and Walker's *hastulifera* is = *americana* Harris. Of 7. *Pharetra*, we have *impressa* Wlk. (*verrillii* G. and R.), and probably others. Of 8. *Arctomyseis*, we have *sperata* Grt. Of 9. *Viminia*, I know of none. 10. *Bisulcia*; our *superans* Guen., must be compared. A comparison of the imago alone has led me to the belief that we are very rich in species of *Triæna*, such as *morula*, *quadrata*. But the great mass of species must yet be compared carefully with the European types and every effort made to keep down the subgeneric synonymy. The following names have it seems, no European representatives:

11. *Megacrorycta* Grt., 1874, type: *americana* (this may fall in with the subgeneric title *Apatela*).
12. *Lepitoreuma* Grt., 1873, type: *ovata*; *incretæ*, *hamamelis*, *hæsitata*.
13. *Mastiphanes* Grt., 1882, type: *xyliniformis*; *edolata*, *extricata*, *pallidicoma*, *lithospila*.

Lepitoreuma is notable from the shape of primaries and the raised scale.

I have said that the groups here indicated are of unequal value and a study of the European species had led me to consider the advisability of uniting 7 and 8, as also 1 and 2. To the extraordinary structure of the larva of *Jocheæra* it would seem in any event right that a separate name should be applied; the imago is near *Triæna*, and from the pupa Dr. Chapman places it in the same group. This type brings up the whole question of "representative" species, a subject full of interest. The imagos of the European and American species show recognizable differences, while the extraordinary larval type has maintained itself apparently unchanged. In the *Annals of the Lyceum of Natural History*, December, 1876, I showed that the differences between such species are shown upon the upper surface of the fore wings chiefly, and of this the species of *Jocheæra* are an example. But Prof. J. B. Smith has shown that between the European *Agrotis augur* L., and the American *Agrotis haruspica* Grt., the most important distinction is to be found in the structure of the male *genitalia*. As I have pointed out, this would prove that the pattern of ornamentation may be more persistent than characters of ultimate structure; since, that both these now separable and separated species had a common origin, admits of no reasonable doubt. In the *Bul. B. S. N. S.*, i, 130, quoted by Prof. Morse in his address before the Section of Biology of the Am. Ass. Adv. Sci., 1876, I showed the probability that the larvæ of *Apatela* had varied

through inheritance or natural selection, influenced by its surroundings and its habits, so that the larval differences have been evolved by a natural protective law. These views have been recently more fully brought out by Mr. Dyar. The moths on the other hand have remained of a more uniform gray color, copying to some extent the bark of the trunks of the trees against which it is their habit to rest in the daytime. Thus it was shown that the larva varied independently of the moth, suiting itself to the very different conditions under which its life was passed. I concluded, in 1876, that the immature stage of growth has submitted independently to modification. I allude to these observations now mainly to show how wonderfully these larval modifications have been retained in the case of the American and European representative species, and to draw attention to the possibility of ascertaining the oldest larval type in the genus, from which the others may have been in time evolved. It would seem as though both protective forms (*Bisuleia*) green like the leaves, and repellant forms (*Jochæara*) occur in this same genus. The usual larval type of *Apatela* may now be found perhaps in *Pharetra*, hairy, gayly colored and bristled, resembling *Aretia*, or again with longer dorsal tufts (*Triana*) recalling *Notolophus*. A light fleecy covering of silky hair in *Acrionicta* may, as Mr. Dyar suggests, be protective; it brings to mind the larva of *Spilosoma*. One of the most beautiful larvæ is that of *Apatela aceris*, the type of the genus, with dorso-lateral tufts of fawn-colored hair enclosing a series of bright markings on the back; it is probably repellant. While Dr. Chapman's studies of the pupæ give us three principal types, it seems that more are afforded, both by the larval and imaginal forms of *Apatela*. A grouping from the imago alone will lead to a different arrangement from that by the larva, or by the pupa. Thus I prefer to increase the subgeneric divisions in this genus in the effort to fit our nomenclature to the facts. Certain of the groups show a greater general correspondence between larva and perfect insect, that is they contain a greater number of species generally agreeing in both stages, these are *Triana* and *Pharetra*. Whether in these groups the species have been more recently separated, as suggested by Dr. Chapman, is a matter of doubt, but seems a reasonable suggestion. This view would fall in with what I have suggested to have happened in other cases, such as *Hemileuca*, *Datana*, *Phalera*. There would seem to be no genus which offers a more interesting field to the biologist for exploration, and the opening afforded by Dr. Chapman's work will guide the student of our richer fauna to still more important results, arising from his larger material.

ROEMER MUSEUM HILDESHEIM, October, 1895.